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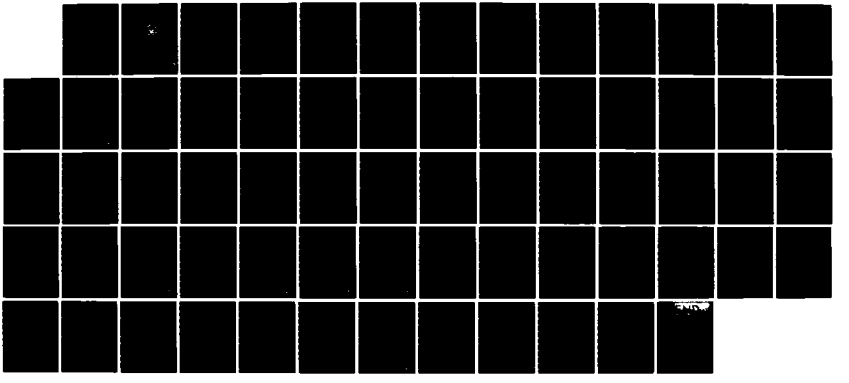

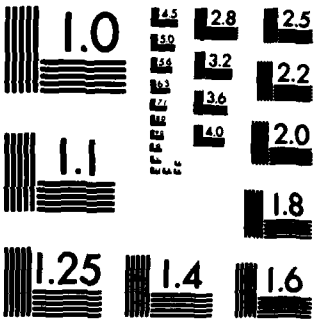

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NPS-012-84-001PR

NAVAL POSTGRADUATE SCHOOL

Monterey, California

A SUMMARY OF THE

FOUNDATION RESEARCH PROGRAM

August 1984

Report for the Period

1 October 1982 to 30 September 1983

Prepared for:
Chief of Naval Research
Arlington, Virginia 22217

Chief of Naval Development
Washington, DC 20360

NAVAL POSTGRADUATE SCHOOL
Monterey, California

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The work reported herein was supported by the Chief of Naval Research, Arlington, Virginia 22217 and the Chief of Naval Development, Washington, DC 20360.

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Foundation Research Program	DOD Recruiting	Military C^3I
Corporate Capital Investment	Filter Structures	Wave Dynamics
Computers and Computing	Moving Targets	Management
Plasma Spray Coating	Fluid Mechanics	Microwaves
Time Series Analysis	Viscous Flow	Acoustics

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Thirty-six projects of Independent Research/Independent Exploratory Development were funded by the NPS Foundation Research Program. This research was in the areas of Computer Science, Mathematics, Administrative Sciences, Operations Research, National Security Affairs, Physics, Electrical Engineering, Meteorology, Aeronautics, Oceanography and Mechanical Engineering. A tabulation in Appendix I identifies area of research and the investigator(s). The category of independent research or independent exploratory research is also identified for each research task.

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OVERVIEW OF THE NPS FOUNDATION RESEARCH PROGRAM FY 1983

The principal thrust of the research and exploratory development program at the Naval Postgraduate School (NPS) stems from its mission:

> To conduct and direct advanced education of commissioned officers, and to provide such other technical and professional instruction as may be prescribed to meet the needs of the Naval Service; and in support of the foregoing to foster and encourage a program of research in order to sustain academic excellence.

A portion of the research performed at NPS is conducted through grants from the Chief of Naval Research and the Chief of Naval Development. Together these funds provide the basis for the NPS Foundation Research Program.

The major objectives of the Foundation Research Program are four-fold and include:

* sponsoring research efforts of junior faculty enabling them to establish a strong research program in their chosen field,
* allowing experienced faculty to change the course of their research programs,
* increasing the general research capability of the Naval Postgraduate School through capital equipment procurement, and
* providing the opportunity for the fulfillment of meritorious research projects that have no sponsor.

The four objectives are pursued with the ultimate goal of stimulating the highest quality research program at NPS in support of the educational program received by students.

The Foundation Research Program is administered internally by a Research Council comprised of selected faculty members. The function of the Research Council is to properly implement the goals and objectives of the program with a view toward approving meritorious proposals submitted by the NPS faculty.

This report describes the accomplishments of the Foundation Research Program for FY 1983. The summaries of the research efforts are organized by academic departments. Some research efforts have been funded by the Chief of Naval Research (6.1) which are oriented toward initiating and conducting scientific and applied research of a long-range nature in areas of special interest to the Navy. Other efforts have been funded by the Chief of Naval Development (6.2) and are used for conducting exploratory development deriving from scientific program areas or in other areas specifically requested by the Navy.

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DEPARTMENT

OF

COMPUTER SCIENCE

Title:	Distributed Deadlock Detection in Distributed Computing Systems
Investigator:	D. Z. Badal, Associate Professor of Computer Science
Sponsor:	NPS Foundation Research Program
Objective:	To investigate deadlock detection in distributed computing systems
Summary:	The new more efficient distributed deadlock detection algorithm was invented.
Publications:	Badal, D. Z. and M. T. Gehl. "On Deadlock Detection in Distributed Computer Systems," Proceedings of the Second Joint Conference of the IEEE Computer and Communication Societies, INFOCOM83, San Diego, April 10-21, 1983, 36-49. Badal, D. Z., and M. T. Gehl. "On Robustness of Deadlock Detection Algorithms for Distributed Computing Systems," Proceedings of the Second International Conference on Computer Science, Santiago, Chile, August 1982.
Conference Presentation:	INFOCOM83, San Diego, April 19-21, 1983.
Thesis Directed:	M. T. Gehl, "Deadlock Detection in Distributed Computing Systems," Master's Thesis, December 1982.

Title:	Computer Software Design
Investigator:	G. H. Bradley, Professor of Computer Science
Sponsor:	NPS Foundation Research Program
Objective:	Develop software tools to support the design and implementation of computer software systems for scientific computations.
Summary:	A comprehensive survey of software design methodologies for developing computer programs for scientific computations was completed. A program family of prettyprinters based on information hiding principles was designed and partially implemented. A computer software system to provide comprehensive checking of data input files was designed, fully implemented and tested. These tools are valuable to designers of scientific software systems.
Publications:	G. H. Bradley, "Check Program for FORTRAN Data Files" (in preparation).
Thesis Directed:	Tae Nam Ahn, "Program Family for Extended Pretty Printer", Master's Thesis, June 1983.

Title:	Design Automation Workbench
Investigator:	Alan A. Ross, Lt. Col., USAF
Sponsor:	NPS Foundation Research Program
Objective:	Install the Computer System Design Environment at NPS, and acquire and integrate a bit-mapped display with the rest of the design system.
Summary:	The objectives have been met. We purchased an AED 767 Video display, installed CSDE on the Computer Science Department VAX 11/780, and a student is just finishing the display integration.
Publication:	Bowers, Jeanne and Alan A. Ross, "Computer System Design Environment Software Development Plan," NPS Technical Report, July, 1983.

Title:	Algorithm Design
Investigator:	D. S. Smith, Associate Professor of Computer Science
Sponsor:	NPS Foundation Research Program
Objective:	To continue the development of approach to automatic algorithm design with a focus on greedy algorithms.
Summary:	Develop a theory of the structure of greedy algorithms from specifications, to formulate, program and test mechanisms for automating these derivations.
Publications:	Smith, Douglas R., "The Structure of Divide and Conquer Algorithms," NPS52-83-002, Technical Report, March 1983.

DEPARTMENT

OF

MATHEMATICS

Title: The Japanese Supercomputer Challenge

Investigator: Raul H. Mendez

Sponsor: NPS Foundation Research Program

Objective: To investigate the newly introduced Japanese Supercomputers. The machines to be introduced in the Fall of 1983 have announced Peak Speeds exceeding those of the current US supercomputers. He review the hardware and software features of these machines as well as the research National projects which resulted in the development of these supercomputers. The possible impact of the Japanese initiative on the US computer market is also investigated.

Publication: R. H. Mendez, "The Japanese Supercomputer Challenge", Siam news, Volume 17, number1/January 1984.

Conference: R. H. Mendez, "The Japanese Supercomputer Chalenge", Mathematics colloqum at NPS and National Defense Academy, Yokosuka, Japan; Fall 1983.

Title:	Numerical Study of Viscous Flow Past Tense Flexible Boundaries.
Investigator:	R. Mendez, Assistant Professor of Mathematics
Sponsor:	NPS Foundation Research Program
Objective:	To develop and test numerical techniques to study the dynamics of vortex sheets.
Summary:	The study of uniform flow past a tense leaflet is of manifest importance to Cardiac Fluid Dynamics. This flow is computed numerically by resolving the vortex sheet along the boundary into a collection of discrete vortices with time-dependent strenghts. The dynamics of the flow can be recovered from that of the vortices along the boundary. Vortex shedding is easily incorporated into the model.
Publications:	Mendez, Raul and Burych, Donna, "Numerical Study of a one-dimensional Tense, Inextensible, Flexible Leaflet". Naval Postgraduate School Report Number NPS-53-83-0009 (December 1983). Mendez, Raul and Peskin, Charles, "A Numerical Method for High Reynolds Number Flow Past a Flexible, Inextensible Leaflet under Tension". Submitted to the SIAM Journal of Stat. and Sci. Comp.
Conference Presentation:	"A Numerical Method for high Reynolds Number Flow Past a Flexible, Inextensible Leaflet under Tension", presented at the Los Alamos Workshop on Vortex Methods, February 22, 1984.

Title:	Computerized Acoustic Impedance Measurement System
Investigator:	James L. Wayman, Adjunct Professor of Mathematics
Sponsor:	NPS Foundation Research Program
Objective:	To furnish the NPS acoustics lab with a system for the measurement of normal acoustic impedance using the Seybert-Ross technique, to validate the system, and to conduct basic research on improving this method of fixed-microphone impedance measurement.
Summary:	The NPS acoustics lab has been equipped with a system using both the Seybert-Ross and the Chung-Blaser methods for measuring normal acoustic impedance in air. Additionally, a water-filled "gun barrel" has been constructed for extending the methods to the underwater environment.
Publications:	Wayman, J.L., "New Methods of Measuring Normal Acoustic Impedance", NPS Technical Report, NPS-53-84-0005.
Conference Presentations:	Invited Paper: "New Methods of Measuring Normal Acoustic Impedance", 105th Meeting of the Acoustical Society of America, Cincinnati, May 1983. Contributed Papers: "Comparison of Impedance Measurement Techniques", Mason, J.T. et al, 106th Meeting of the Acoustical Society of America, San Diego, November 1984. "Effect of Sealants of the Sound Absorption Coefficients of Acoustical Friable Insulating Material", Lory, M.K. and Wayman, J.L., 106th Meeting of the Acoustical Society of America, San Diego, November 1984.
Thesis Directed:	J.T. Mason, "Comparison of Impedance Measurement Techniques", Master's Thesis, December 1984.

DEPARTMENT

OF

ADMINISTRATIVE SCIENCES

Title: The Internal Allocation of Corporate Capital

Investigator: Philip Bromiley, Assistant Professor,
Department of Administrative Sciences

Sponsor: NPS Foundation Research Program

Objective: To increase understanding of the factors influencing the allocation of corporate resources across alternative corporate business areas.

Summary: The research program has three main thrusts. First, actual allocation procedures in corporations are investigated by (a) interviews with corporate employees involved in capital allocation, (b) modelling of allocation processes, and (c) estimation of models. Second, alternative models of the level of corporate capital investment are being compared on the basis of prediction (with Dan Boger). Third, parsimonious explanations for empirical results on production functions are being explored (with Herbert Simon).

Publications: "The Determinants of Corporate Capital Investment: A Behavioral Approach," submitted to the Journal of Economic Behavior and Organization.

"A Comparison of Behavioral and Neo-Classical Conceptions of Investment," submitted to the Journal of Economic Behavior and Organization.

"Planning Systems and Corporate Behavior: A Process Approach," submitted to Strategic Management Journal.

A Behavioral Investigation of Corporate Capital Investment, forthcoming book to be published by Cambridge University Press.

Title: A Mathematical Programming Model Management System Based upon Artificial Intelligence Techniques

Investigator: Daniel R. Dolk, Assistant Professor of MIS

Sponsor: NPS Foundation Research Program

Objective: To study the applicability of artificial intelligence (AI) techniques, especially knowledge representation, to the design and development of generalized software systems that solve mathematical programming models.

Summary: A survey of knowledge representation techniques was conducted to determine the relative strengths and applicability of various representations for modeling purposes. A hybrid of the techniques in the form of a model abstraction was developed for use with math programming models. The model abstraction most resembles the AI frame concept in structure and function. A prototype model management system (GXMP) based on the model abstraction was implemented for linear programming models. The GXMP system has been tested successfully with several LP problems and shows promise as a generalized modeling system. Several features need to be added including inference and knowledge manipulation capabilities and other MP models (*e.g: nonlinear* optimization) to demonstrate its generality. Efforts have begun to develop this new version.

Publications:

D. R. Dolk and B. Konsynski; "Knowledge Representation for Model Management systems"; submitted to IEEE Transactions on Software Engineering, July 1983.

D. R. Dolk; "A Knowledge-Based Model Management System for Mathematical Programming"; submitted to ACM Transactions on Mathematical Software, September 1983.

D. R. Dolk; "A Knowledge-Based System for LP Modeling"; NPS Technical Report, NPS-54-83-012, September 1983.

Conference Presentation:

D. R. Dolk; "A Knowledge-Based System for LP Modeling"; ORSA/TIMS 1982 Joint National Meeting in San Diego.

Theses Directed:

G. W. Watson, Jr.; "Knowledge Base Management for Model Management Systems"; Master's Thesis; June 1983.

John J. Troy; "Model Statement Language/Analyzer"; Master's Thesis; June 1983.

Title:	An Investigation of the Federal Government's Information Needs and Uses for Depreciation
Investigator:	James M. Fremgen, Professor of Accounting, Department of Administrative Sciences
Sponsor:	NPS Foundation Research Program
Objective:	To identify actual and potential users of Federal financial reports, to determine the natures of their uses of the information, and to assess the relevance of depreciation to those uses.
Summary:	A survey of the theoretical literature and official pronouncements on governmental accounting was made to identify issues regarding depreciation accounting. These issues were used as the basis for structured interviews with Federal accounting policy makers and accounting data users in both the legislative and executive branches. Current actual practices in the Federal government were determined and compared with those in municipal governmental accounting.
Conference Presentation:	"On the Role of Depreciation in Governmental Accounting". To be presented at the Western Regional Meeting of the American Accounting Association on April 20, 1984.
Publications:	Fremgen, James M., "On the Role of Depreciation in Governmental Accounting", submitted to the Journal of Accountancy.

Title:	Development of a Framework for Management Control and Assessment of the State of the Art in Business Firms
Investigator:	Solange Perret, Assistant Professor of Accounting
Sponsor:	NPS Foundation Research Program
Objective:	To examine the current budgeting practices of the Fortune first and second 500 largest U.S. firms, and to assess the validity of a contigency model which states that in order to be successful, firms need to adapt their environment (simple versus static, and stable versus dynamic)
Summary:	Firms in four industries were surveyed (Apparel, Aerospace, Chemical and Wood), each of these industries representing a different type of environment. There was a characteristic profile of budgeting practices in each industry, and the four profiles were significantly different. Furthermore, the nature of the differences was consistent with hypotheses formulated from the contingency model.
Publications:	In Progress: "Environmental Uncertainty and Budgeting Practices: A Comparison of Budgeting Practices in Four Industries".
Thesis Directed:	Lt. Michael O. Roesner, "An Analysis of Budgeting in Four Industries", December, 1983.

Title: Development of a Model for Effective Cross-Cultural Interactions Within Organizations

Investigator: Solange Perret, Assistant Professor of Accounting

Sponsor: NPS Foundation Research Program

Objective: To study the impact of cultural differences on management practices in multinational organizations, and to initiate the development of a framework for designing management systems adapted to multicultural environments.

Summary: The study was conducted in four locations (England, France, Holland, and the USA) of a large multinational accounting firm. The study showed that the definition of quality for the services provided varied substantially between the four countries. (Quality was defined as what the partners felt quality meant in their work and as what the client firms required from their accounting firm.) Furthermore, the differences in the definition quality were strongly related to specific cultural differences as measured with the Kluckhohn and Strodtbeck instrument. Conclusions were that this instrument is valid to identify some major differences between cultures and can be used to design management systems adapted to specific cultural environments.

Publications: Preliminary report for the participating company.

In progress: "The Impact of Cultural Differences on Management Practices in Four Countries'.

Ready for submission to the Academy of Management Review: The Different Meanings of Time: Differences Between Cultures and Their Impact on Managerial Processes in Multinational Orgaization'.

Title: The Impact of Organizational Constraints on the Design and Implementation of Management Information Systems

Investigator: Joseph G. San Miguel, Professor of Accounting, Department of Administrative Sciences

Sponsor: NPS Foundation Research Program

Objective: The objective of this research project was to examine the impact that organizational constraints such as stated goals and objectives, organizational structure, critical factors concerning the nature or economics of operations, and others have on the design and implementation of management information systems. Field work was carried out to test several research hypotheses.

Summary: All large, complex organizations, profit oriented as well as those that are nonprofit oriented, have decentralized or hierarchical responsibility for the management of resources that are available to the organization. Resources typically consist of humans (managers and workers), physical items (inventories, equipment, building), and financial (cash and other funds) means. A rigorous analysis of each organization helps identify certain characteristics that are invariant over a relatively long time frame (e.g., three to five years). These characteristics can be viewed as constraints or givens because changes are relatively infrequent. Also, changes require major policy decisions of top managers and the board of directors or some other governing body. The organizational constraints identified in this research as having significant influence on the design of management information systems were: organizational structure; organizational goals and objectives; and the nature or economics of major operating activities or businesses.

The results of the research demonstrate that the design of an effective management information system for a particular organization depends on a careful assessment of its organizational constraints. Organizational structure formally defines how an organization divides its resources among managers who are held responsible for their efficient and effective utilization. Goals and objectives provide guidelines to help motivate each manager to do a good job. An understanding of the

nature or economics of the operations helps identify key variables that determine whether or not the organization will succeed or fail in reaching its goals and objectives.

Field research within one organization engaged in service operations helped confirm the importance of the organizational constraints in the design of information systems to help managers achieve satisfactory performance. Three criteria for success were: minimizing service time, meeting planned completion date, and cost effectiveness. In this particular setting the organization, which is a subdivision of a larger organization, was held responsible for meeting certain profit goals that were beyond its control. However, in practice, management was only marginally concerned with this imposed objective. Instead their decision making was primarily concerned with the above three success factors. This research raised a serious question as to imposed profit objective in light of the lack of influence that exists over the price that is charged for service.

Publications:

J. G. San Miguel, "A Constraint Based Framework for Management Planning and Control Systems," in progress.

J. G. San Miguel, "The Effectiveness of Management Control in Service Organizations: A Field Study," in progress.

Thesis Directed:

Anne Long, "Cash Management in the Naval Industrial Fund," Master's Thesis, in progress.

Title:	Theoretical Understanding of Recruiting Source Consequences
Investigator:	Thomas G. Swenson, Assistant Professor, Department of Administrative Sciences
Sponsor:	NPS Foundation Research Program
Objective:	To develop a framework for the theoretical understanding of recruiting source characteristics and organizational consequences.
Summary:	To date: 1. Review of relevant literature to the private sector has been completed and a review of recruiting literature DoD-wide is in progress. 2. Theoretical framework for understanding the organizational consequences of recruiting source consequences has been completed. 3. Private sector data base has been collected and extensive analysis is nearing completion. Also U.S. Coast Guard data base has been developed in conjunction with thesis by Harvey Johnson. 4. Work has recently been completed on a conceptual paper, co-authored with CDR Mairs, on the strategic evaluation of recruiting sources. 5. Conceptual paper dealing with the strategic evaluation of recruiting sources is being extended with the assistance of Bob Butler of the Assessment Group into a paper which develops a mathematical model of recruiting source effectiveness that evaluates recruiting sources from the perspective of return on investment.

DEPARTMENT

OF

OPERATIONS RESEARCH

Title:	The Optimal Search for a Moving Target when the Search Path is Constrained
Investigator:	J. N. Eagle, Associate Professor of Operations Research
Sponsor:	NPS Foundation Research Program
Objective:	The objective of this research was to propose and investigate a partially observable Markov decision process (POMDP) technique for solving the discrete time and space moving target problem when the searcher's motion is subject to path constraints.
Summary:	A search is conducted for a target moving in discrete time among a finite number of cells according to a known Markov process. The searcher must choose one cell in which to search in each time period. The set of cells from which he can choose is a function of the cell chosen in the last time period. The problem is to find a search path, i.e., a sequence of search cells, that maximizes the probability of detecting the target in a fixed number of time periods. The problem is formulated as a POMDP. A finite time horizon POMDP solution technique is suggested which is simpler than the standard linear programming methods.
Publications:	J. N. Eagle, "The Optimal Search for a Moving Target when the Search Path is Constrained," NPS Technical Report, NPS55-83-014, August 1982, Revised May 1983. J. N. Eagle, "The Optimal Search for a Moving Target when the Search Path is Constrained," Operations Research, forthcoming.
Thesis Directed:	D. B. Guthe, "Optimal Search for the Wake of a Moving Target when Search Motion is Constrained," Master's Thesis, September 1983.

Title:	Multivariate Time Series Analysis and Modelling of Oceanographic/Meteorological Data
Investigators:	P. A. Jacobs, Associate Professor of Operations Research, and P. A. W. Lewis, Professor of Operations Research
Sponsor:	NPS Foundation Research Program
Objective:	To develop the capability to examine time series graphically and statistically and to use the capability to analyze oceanographic and meteorological data.
Summary:	A graphical time series package using the IBM experimental graphics package GRAFST3 was developed. The developed time series package and GRAFST3 were used to examine meteorological and oceanographic time series.
Publications:	P. A. W. Lewis et al. "Documentation for graphical time series package." Forthcoming. P. A. Jacobs. "A pilot data analysis of sea surface temperatures and wind speeds measured on oceanic weather ship PAPA - a summary." NPS Technical Report. In progress.

Title:	Lanchester-Type Models that Reflect Spatial Distribution of Forces
Investigator:	J.G. Taylor, Professor of Operations Research
Sponsor:	NPS Foundation Research Program
Objective:	To formulate for tactical situations of interest Lanchester-type models that reflect spatial distribution of forces based on a continuum-mechanics approach to modelling combat and to investigate the development of analytical/numerical solutions to such distributed-parameter formulations.
Summary:	Some Lanchester-type combat models that reflect the continuous (at least almost everywhere) spatial distribution of two homogeneous forces on a one-dimensional battlefield were developed. By combining ideas from traffic and combat theories, this work developed for modern combat between conventional-purpose ground forces a continuous-mechanics paradigm that explicitily considers both attrition and force movement. Attrition is modelled by a Lanchester-type continuity equation (actually an integro-partial-differential equation) for each side's force density, while movement is modelled by a functional relation between each side's velocity and the force densities, battlefield location, tactical-decision variables, and force-movement strategies. An exact analytical solution in a special case of tactical interest (attrition occurring only for forces in direct contact) was developed by means of Riemann's method for the special case in which each spatially-distributed force moves with its own constant speed at all locations on the one-dimensional battlefield.
Publications:	J.G. Taylor, "Lanchester-Type Models that Reflect Continuous Spatial Distribution of Forces," pp. 302-312 in Modelling and Simulation of Land Combat, L.G. Callahan (ed.), The Georgia Tech, Research Institute, Atlanta, GA, 1983. J.G. Taylor, "Analytical Solution to a Lanchester-type Combat Model that Reflects the Continuous Spacial Distribution of Forces with Constant Force-Movement Speeds," submitted to Int. J. Systems Science. J.G. Taylor, "Some Lanchester-Type Combat Models that Reflect Continuous Spatial Distribution of Forces," submitted to Naval Research Logistics Quarterly.
Conference Presentation:	J.G. Taylor, "Soviet Methodological Advances in Combat Modelling," TIMS/ORSA Chicago Meeting, Chicago, IL, 26 April 1983.

Title:	Reliability Evaluation of Binary Systems
Investigator:	R. K. Wood, Assistant Professor of Operations Research
Sponsor:	NPS Foundation Research Program
Objective:	To develop and implement new techniques for evaluating the reliability of binary systems represented as networks and fault trees.
Summary:	Special state-space partitioning techniques together with topological reduction and decomposition methods have been developed for computing source-to-K-terminal reliability in acyclic directed networks. Good lower bounds on reliability have been shown to be achievable by truncating exact calculations. Techniques for analyzing factoring algorithms for computing reliability in undirected networks have been extended to directed networks. A factoring algorithm for fault-tree evaluation has been devised and its implemetation begun.
Publications:	R. K. Wood, "Factoring Algorithms for Computing Network Relability," NPS Technical Report, forthcoming. A. Agrawal, R. K. Wood, and C. Lee, "Computing Source-to-K-Terminal Reliability in Directed Acyclic Networks," NPS Technical Report, forthcoming.
Conference Presentation:	A. Agrawal, R. K. Wood and C. Lee, "Computing Source-to-K-Terminal Reliability in Directed Acyclic Networks," NSF Network Reliability Workshop, Stevens Institute of Technology, Hoboken, New Jersey, August 24-26, 1983.
Theses Directed:	C. Lee, "Computing Source-to-K-Terminal Reliability in Directed Acyclic Networks," Master's Thesis, September 1983. R. Robison, "A Factoring Algorithm for Fault Tree Evaluation," Master's Thesis, March 1984

DEPARTMENT

OF

PHYSICS

Title:	Acoustic propagation from a fluid wedge into an underlying fluid substrate of greater sound speed.
Investigators:	Alan B. Coppens, Associate Professor of Physics James V. Sanders, Associate Professor of Physics M. Humphries, Adjunct Professor of Mathematics
Sponsor:	NPS Foundation Research Program
Objective:	To formulate theoretical expressions based on a method of images approach to the propagation of sound in a wedge which will describe the sound field generated in the underlying fluid layer.
Summary:	The method of images was used to calculate the pressure on the interface between the wedge and the layer. The Green's function integral was then used to predict the sound field in the substrate. Evaluation was accomplished with the help of the saddle point integration methods and and end point method. A random phase approximation provided a simple closed form for the sound beam in the bottom which was in good agreement with other theoretical approaches to the problem. The various expressions were analyzed to determine phase coherent interference effects and quantitative agreement with methods based on solutions to the Parabolic Equation and with methods based on variations of matched asymptotic expansions.
Publications:	A. B. Coppens, M. Humphries, and J. V. Sanders, "Propagation of a sound beam out of a fluid wedge into an underlying fluid substrate of greater speed," submitted to Journal of the Acoustical Society of America.
Conference Presentations:	A. B. Coppens and M. Humphries, "Coherence and the beam of sound projected into an acoustically fast fluid bottom from an overlying sound-bearing wedge," 105th Meeting of the Acoustical Society of America, J. Acoust. Soc. Am. Suppl. 1, 73, S68 (1983)

Title: Absolute Electroacoustic Measurement of Temperature Variations in Superfluid ^{4}He.

Investigator: S. L. Garrett, Assistant Professor of Physics

Sponsor: NPS Foundation Research Program

Objective: To test an extension of the reciprocity theorem for absolute electroacoustic calibration to mechanical, reversible, thermal (second) sound transducers in a quantum fluid.

Summary: An experiment was performed which has verified for the first time an extension of the reciprocity calibration technique to reversible thermal transducers in superfluid helium. A plane-wave resonator of circular cross-section was capped at both ends by reversible teflon slit-electret diaphragms to generate or detect thermal waves. The resonator also incorporated a heater and a d.c. - biased carbon resistance thermometer to set independent upper and lower limits on the thermal excursions within the resonatory. The tempeature excursions measured by the reciprocity method fell between the upper and lower limits, which, for lower modes, were separated by only a few percent. For higher modes, the lower limit departed from the upper limit due to the thermal inertia of the resistance thermometer, but the reciprocity result remained only a few percent below the upper bound set by the thermophone over nearly a decade in frequency. The "slit-electret" transducers had sensitivities in excess of 100 V/°K, and temperature oscillations as small as 10^{-10} °K/(Hz/$^{1/2}$) were detectable.

Publications:

S. L. Garrett, "Reciprocity Calibration of Second Sound Transducers in Superfluid ^{4}He", Physical Review B, in progress.

J. Valdivia, Jr., R. B. Ogg, and S. L. Garrett, "Absolute Electroacoustic Measurement of Temperature Oscillations in Superfluid ^{4}He by the Reciprocity Method", Physical Review Letters, in progress.

Title: Microwave Cerenkov Radiation

Investigator: J. R. Neighbours, Professor of Physics
F. R. Buskirk, Professor of Physics

Sponsor: NPS Foundation Research Program

Objective: To develop quantitative understanding of the microwave radiation from a periodic charged particle beam.

Summary: Microwave radiation in both X and K band has been detected when the NPS linac beam is allowed to propagate in air. This radiation has been identified as resulting from coherent Cerenkov radiation occuring as a result of collective radiation by each of the electron bunches in the linac beam. A theory of the effect has been developed and current research efforts are directed towards testing its range of validity. The radiated power as a function of frequency is of particular interest.

Publications:

"Cerenkov Radiation from Bunched Electron Beams", by F. R. Buskirk and J. R. Neighbours, Naval Postgraduate School Report Number NPS-61-83-003 (October 1982)

"Diffraction Effects in Cerenkov Radiation", by J. R. Neighbours and F. R. Buskirk, Naval Postgraduate School Report Number NPS-61-83-010 (June 1983)

"Cerenkov Radiation from Periodic Electron Bunches", by F. R. Buskirk and J. R. Neighbours, Physical Review A. 28, 1531-1538, (Sept. 1983)

"Cerenkov Radiation from a Finite Gas Cell", by J. R. Neighbours, F. R. Buskirk, and A. Saglam, accepted for publication in Physical Review A.

DEPARTMENT

OF

ELECTRICAL AND

COMPUTER ENGINEERING

TITLE: Computer Region Segmentation of Serial Photographs

INVESTIGATOR: Chin-Hwa Lee, Associate Professor of Electrical Engineering

SPONSOR: NPS Foundation Research Program

OBJECTIVE: To collect experimental results of the recursive splitting with hierarchical scopic views segmentation algorithms.

SUMMARY: A recursive splitting method at hierarchical scopic levels has been implemented. The two main problems, the splitting criteria and the boundary discontinuity problems are studied. The proposed solution will be tested on the digital imagery sets. Additional experimental results are collected to substantiate the effectiveness of the solutions.

PUBLICATIONS: Chin-Hwa Lee, "Interpolation of Weighted-Average Samples Using Cubic B-Spline Function, Proceedings of IEEE Vol. 71 No. 4, April 1983.

Chin-Hwa Lee, "A Bus Monitoring Controller," Proceedings of Mini-Micro Computers and Their Applications, May 16-17, 1983.

CONFERENCE PRESENTATION: Chin-Hwa Lee, "A Bus Monitoring Controller," Mini-Micro Computer Conference, San Francisco, CA, May 16-17, 1983.

Title:	Perturbative Model Analysis of the Back-Scattering Characteristics of a Missle over Several Frequency Bands
Investigator:	Hung-Mou Lee, Assistant Professor of Electrical Engineering
Sponsor:	NPS Foundation Research Program
Objectives:	(1) To develop an analytic theory on the scattering of electromagnet waves from tubular cylinders of finite length. This will add to the list of only a few finite sized objects of which the vector scattering problems have been analytically solved. (2) To apply this theory toward the identification of targets with increasingly complex shapes.
Summary:	Analytic formulations to compute the surface current on a finite cylinder were derived. Computer codes were written and are being debugged in order to facilitate the evaluation of the analytical solutions over a 18:1 frequency range. This theory led to the identification of the modes of surface currents responsible for the resonances at different frequencies. An immediate application is to investigate the changes in resonance modes caused by a small change in the geometry of the cylinder. Experimental data to be accumulated in this study will help the identification of different targets. Acquisition of laboratory equipments was completed. They are being assembled so that automatic measurements of phase and magnitudes of back scattered waves can be performed.
Publications:	"Double series expansion of the Green's function for a perfectly conducting tubular cylinder of finite length." Radio Science 18(1), 48-56, January-February 1983.
Conference Presentations:	"Scattering current on a circular, tubular, perfectly conducting cylinder of finite length." Presented at the joint USNC/URSI Meeting and the IEEE International Symposium of AP-S in May 1983 at Houston, with the abstract published in the URSI Proceedings.

TITLE: Cybernetic Models of Military C^3I

INVESTIGATORS: Paul H. Moose, Associate Professor of Electrical Engineering

SPONSOR: NPS Foundation Research Program

OBJECTIVE: Investigate the sensitivity of system stability to the basic assumptions regarding the mechanisms coupling counter-C^3 actions to intelligence information.

SUMMARY: Five different two-species non-linear evolution equations were analyzed. They model, respectively, (1) mixed attrition Lanchester combat with replenishment, (2) four different models of "information war". Their dynamical properties were determined, and it has been shown that four of the five are environmentally unstable. The meaning of this for, C^3I and counter-C^3 is that until the basic mechanisms of information war are ascertained, it is impossible to predict whether deception and other counter-C^3 measures are fundamentally stabilizing or destablizing factors in modern warfare. An experimental approach is now needed to determine what coupling mechanisms are in fact at work before further analytical progress will be possible.

PUBLICATION: P. H. Moose, "Evolution Equations of C^3I: Cononical Forms and Their Properties," NPS-62-83-059, October 1983, A135293.

TITLE: Fin-Line Bandpass Filter Structures for Use at Microwave and Millimeter Wave Frequencies

INVESTIGATORS: Y. C. Shih, Adjunct Professor of Electrical Engineering, and K. G. Gray, Associate Professor of Electrical Engineering

SPONSOR: NPS Foundation Research Program

OBJECTIVE: To analyze and design bandpass filter structures in finline for use at microwave and millimeter-wave frequencies.

SUMMARY: The complex-power conservation technique was studied and applied to analyze the discontinuities in filter structures. The resulting scattering parameters were then used in a synthesis technique based on a distributed half-wave step-impedance filter prototype. Two types of filters, the E-plane fin-line filter and the evanescent-mode waveguide dielectic-resonator filter, were designed. Some preliminary designs were tested at x-band and k-band with good results.

CONFERENCE PRESENTATION: Y. C. Shih and K. G. Gray, "Convergence of Numerical Solutions of Step-Type Waveguide Discontinuity Problems by Modal Analysis," 1983 IEEE-MTT-S Intl. Microwave Symposium, Boston, MA, May 3 - June 3, 1983.

THESIS DIRECTED: K. Alexander and S. Hamel, "Analysis and Design of Fin-Line Filters," Master's Thesis, September 1983.

TITLE: Underwater Acoustic Propagation and Scattering in a Random Ocean - A Linear Systems Theory Approach

INVESTIGATOR: L. J. Ziomek, Assistant Professor of Electrical Engineering

SPONSOR: NPS Foundation Research Program

OBJECTIVE: To derive transfer functions and coherence functions of the random ocean medium based upon the WKB and parabolic equation approximations. By coupling the transfer functions to various transmit signals and transmit and receive apertures, problems in pulse propagation, underwater acoustic communication, and target detection will be studied via computer simulation of the derived mathematical expressions.

SUMMARY: Wave propagation in a random, inhomogeneous ocean was treated as transmission through a linear, time-variant, space-variant, random communication channel. A consistent notation (vis-a-vis ad hoc), fundamental input-output relations, and various time-space transformations for both deterministic and random linear, time-variant, space-variant, filters were established. Using the method of separation of variables and the WKB approximation, a time-invariant, space variant, random transfer function of the ocean volume was derived. The ocean volume was characterized by a random index of refraction which was a function of depth. The index of refraction was decomposed into a deterministic component and a zero mean random component. In addition, two example calculations were made. The first example involved the derivation of the equations for the random, output electrical signals at each element in a receive planar array of complex weighted point sources in terms of the frequency spectrum of the transmitted electrical signal, the transmit and receive arrays, and the transfer function of the ocean medium. The second example involved the derivation of the coherence function, i.e., the autocorrelation function of the transfer function.

PUBLICATION: L. J. Ziomek, "Linear Time-Variant Space-Variant Filters and the WKB Approximation," NPS Technical Report, forthcoming.

CONFERENCE PRESENTATION:

L. J. Ziomek, "Undersea Acoustic Propagation in a Random Ocean - A Linear Systems Theory Approach," 1983 DARPA Undersea Surveillance Symposium, Monterey, CA, 18-22 July 1983.

DEPARTMENT

OF

METEOROLOGY

Title:	Analysis of Aircraft Measurements of the Atmospheric Boundary Layer (ABL)
Investigator:	W. J. Shaw, Postdoctoral Associate
Sponsor:	Naval Postgraduate School Foundation
Objective:	Extension of analysis of JASIN Experiment aircraft data.
Summary:	The research effort consisted of further examination of the properties and coherence of plume-like structures in the near-neutral marine boundary layer using the JASIN data base to generate cross-correlation functions derived from energy dissipation time series.
Publications:	W. J. Shaw and J. A. Businger, "Intermittency and the organization of turbulence in the near-neutral marine atmospheric boundary layer," (To be submitted to Journal of the Atmospheric Sciences), in progress.
Conference Presentations:	W. J. Shaw, "Intermittency and the Organization of Turbulence in the Near-neutral Marine Atmospheric Boundary Layer," American Meteorological Society Sixth Symposium on Turbulence and Diffusion, Boston, MA, March 22-25, 1983.

DEPARTMENT

OF

AERONAUTICS

Title:	Wave Rotors and Wave Engines
Investigator:	Dr. R. P. Shreeve, Director, Turbopropulsion Laboratory (TPL), Department of Aeronautics
Sponsor:	NPS Foundation Research Program
Objective:	To develop computational techniques to analyze the performance of and flows within wave devices and to show through an experimental program that they work.
Summary:	An extensive literature survey of publications and proposals related to wave rotor and cycle analyzes has been carried out. A Riemann problem solver code has been used to determine viable cycles for wave rotors, with special emphasis on an impulse turbine mode application. A method of characteristics (MOC) code was developed as a flow solver to partially predict the effect of wave structure in the rotor. This development highlighted some of the shortcomings of the MOC techniques and outlined the need for a unified and comprehensive code which can solve the flow structure in detail. Work has been initiated in this direction. The literature search indicated the lack of a theoretical analysis of the wave phenomena in any one class of wave rotors. Such an analysis has been started (presently for one class of wave rotors), and is expected to give some insight into the constraints and conditions required for efficient operation of these devices. The analysis is based on unsteady gasdynamical equations. The design of a wave rotor experiment has been completed and the apparatus is in the procurement/assembly phase. Assembly and initial tests are expected in early 1984.
Publications:	S. Eidelman, A. Mathur, R. P. Shreeve and J. Erwin, "Application of Riemann Problem Solvers to Wave Machine Design," AIAA Technical Note (forthcoming). R. P. Shreeve, A. Mathur. S. Eidelman and J. Erwin, "Wave Rotor Technology Status and Research Progress Report," Naval Postgraduate School Report No. NPS67-82-014PR, November 1982.
Conference Presentation:	A. Mathur, "Wave Rotor Research Program at TPL, Naval Postgraduate School," Seminar held at Mathematical Sciences Northwest, Seattle, Washington, August 1982.

DEPARTMENT

OF

MECHANICAL ENGINEERING

Title:	Surface Effects On Plasma Spray Coating Protectivity
Investigator:	Donald H. Boone, Adjunct Research Professor
Sponsor:	NPS Foundation Research Program
Objective:	To understand the effect of post coating processing treatments on the protective oxide formation and adherence formed on plasma spray applied coatings.
Summary:	An active element effect as characterized by the presence of oxide 'pegs' was identified for the Hf containing CoCrAl coating. Post coating operations and their sequence of application were found to influence oxide adherence for the active element containing coating. Surface polishing followed by a peening operation was found to be the most beneficial. No effect of post coating processing operation was found for the active element free coating. Further studies are planned to evaluate these effects in hot corrosion testing.

Title:	C.A.E. (Computer Aided Engineering) with an APOLLO computer
Investigator:	Gilles Cantin, Professor of Mechanical Engineering
Sponsor:	NPS Research Foundation Program
Objective:	The APOLLO computer is a new breed of work station especially well adapted for C.A.E. applications. The GRAPHICS capabilities and computing power make it easy to use with many existing systems.
Summary:	The system was delivered late in December 1983. Its usage will be covered in next year's activity report. However, it can already be said that CAL/NPS has been installed and is working. The GIFTS system installation will require GRAPHICS interface, but this is well under way.

Title:	Experimental Investigation of the Fluid Mechanics of Buoyant Jets and Plumes
Investigator:	William G. Culbreth, Assistant Professor of Mechanical Engineering
Sponsor:	NPS Foundation Research Program
Objective:	To investigate the fluid mechanical and heat transfer properties of submerged buoyant jets. Velocity distributions are determined by Laser Doppler Velocimetry. Measurements are to be carried out for various crossflow to jet flow ratios and jet injection angles.
Summary:	A Laser Doppler Velocimeter has been interfaced to an HP-9826 computer and a three-dimensional transversing bed has been installed for the LDV. Software has been written that automatically transfers data from the LDV to the microcomputer and to the IBM 3033 via modem. Results have shown that the behavior of the length of the zone of flow establishment is a strong function of the jet nozzle Reynolds number and is not constant for non-buoyant jets, as previously assumed. Data has been acquired along the stream-wise axis of jets in crossflow.
Thesis Directed:	M. D. Wessman, "Measurement of Velocity Distributions in Turbulent Jets using Laser Doppler Velocimetry," Master's Thesis, June 1983.

Title:	Analysis of Film Condensation Heat Transfer on Vertical Fluted Tubing
Investigators:	V. K. Garg, Adjunct Professor of Mechanical Engineering, and P. J. Marto, Professor of Mechanical Engineering
Sponsor:	NPS Foundation Research Program
Objective:	To analyze film condensation heat transfer upon vertically fluted tubing.
Summary:	An analysis of film condensation on a vertical fluted tube has been made considering gravitational and surface tension effects over the entire fluted surface, and using surface-oriented coordinates. For the first time, surface tension effects are determined, as they should be, from the shape of the flute. Two-dimensional conduction within the condensate film, as well as in the fluted tube, is considered. A finite-difference solution of the highly non-linear partial differential equation for the film thickness is coupled with a finite-element solution of the conduction problem. The procedure has been tested on a sinusoidal flute with amplitude to pitch ratio $\sim$0.2. A linear extrapolation, on a log-log basis, of the results shows good comparison with experimental data.
Publications:	V. K. Garg and P. J. Marto, "Heat Transfer Due to Film Condensation on Vertical Fluted Tubes," NPS 69-84-003, June, 1984. V. K. Garg and P. J. Marto, "Laminar Film Condensation on a Vertical Fluted Tube," Proceedings Third International Conference on Boundary and Interior Layers, Dublin, Ireland, June, 1984.

Title:	Determination of the Influence of Processing History on the Carbon Content of the Martensite in a High-Carbon Bearing Steel by X-ray Diffraction
Investigators:	T. R. McNelley, Associate Professor of Mechanical Engineering and A. Garg, Adjunct Research Professor of Mechanical Engineering
Sponsor:	NPS Research Foundation Program
Objective:	Development of an X-ray technique, based on separation of diffracting peaks into doublets as a result of tetragonality, to determine the carbon content of the martensite in a high-carbon bearing steel and application of the method to evaluate the effect of the processing history of the steel.
Summary:	Conventional, as-received AISI 52100 steel and the same material subjected to a grain-refining thermomechanical treatment were studied in this program. Samples from both were austenitized over a series of temperatures ranging from 820°C to 1,000°C. X-ray diffraction patterns were obtained with particular attention given to recording the {200} doublet. The data was analyzed by fitting the doublet with a Pearson VII type function which assumes the doublet to be made up of two overlapping symmetrical peaks, one for the (200), (020) pair and one for (002). When the individual peak positions were known, the carbon content of the martensite could be determined by measuring the angular difference in peak position $\Delta\theta$ and then using data in the literature relating carbon content of martensite to lattice spacing and hence to diffraction peak positions. The data so obtained was shown to be identical to carbon content determination by the more tedious carbide extraction replica method.
Thesis Directed:	E. V. Bres, "The Heat Treatment Response of Thermomechanically Processed M-50 Steel", Masters Thesis, December 1983.
Paper Submitted:	T. R. McNelley and A. Garg, "Determination of the Effect of Austenitizing Temperature on Carbon Content of Martensite in AISI 52100 Steel by X-ray Diffraction", submitted to Journal of Heat Treating

Title:	Numerical and Experimental Studies of Non-Linear Transient Dynamic Responses Submerged Structures under Shock and Vibration Environments.
Investigator:	Y. S. Shin, Associate Professor Mechanical Engineering
Sponsor:	NPS Foundation Research Program
Objective:	(1) To look into the insight of the large deflection elastic-plastic transient response characteristics of submerged ductile structures in the vibro-acoustic shock loading condition, and (2) to develop experimental correlations among the shock source intensities, near- and far-field acoustic pressures and the corresponding structural responses, and also to validate the predicted result with that of the experiments.
Summary:	The state-of-the-art technology review was performed and the various numerical methods for the shock response analysis of the submerged structures were evaluated. The conceptual studies of non-linear transient response analysis subjected to underwater shock are in progress. PATRANG interactive color graphics program was installed in NPS VAX computer and Ramtek 6211 graphics terminal was installed, and both are in operational. The extensive pre- and post-processing capabilities have been developed in color modes that facilitate the complex response phenomena easier to understand. HP-5451C Fast Fourier Transform Analysis System was acquired and installed in Bldg. 500. The system is in full operation since May, 1983.
Publication:	Y. S. Shin and M. K. Chargin, "Acoustic Responses of Coupled Fluid-Structure System by Acoustic-Structural Analogy," The Shock and Vibration Bulletin, May 1983.
Conference Presentation:	Y. S. Shin and F. Daube, "Underwater Shock-Induced Responses of Submerged Cylindrical Shell," Submitted for the presentation at Symposium on Flow-Induced Vibration at the 1984 ASME Winter Annual Meeting, New Orleans, Louisiana, December 9-13, 1984.

Thesis Directed:	Four students are working in this area for their Master's thesis.

Title:	Reliability-based Analysis of Random High Cycle Fatigue Life.
Investigator:	Y. S. Shin, Associate Professor of Mechanical Engineering
Sponsor:	NPS Foundation Research Program
Objective:	To develop the reliability-based analysis method of high-cycle fatigue life under the random vibration environments, and to develop a related computer program to evaluate the fatigue life as a probability of survival.
Summary:	The collection of test results shows that a Weibull distribution function is found to be a best probability model for the critical fatigue damage index. The analytical equations were formulated. A compute program, "FATIGUE," was developed and is in operational in IBM computer. Parametric studies were performed to evaluate the sensitive parameters to fatigue life. The need to develop a fatigue life prediction for the multi-axial state of stress was identified and the efforts have been made to look into the details of fatigue failure criterion.
Publication:	Y. S. Shin and R. W. Lukins, "Probability-based High-cycle Fatigue Life Predictions," Submitted for the publication in ASME Journal of Pressure Vessel Technology.
Conference Presentation:	Y. S. Shin and R. W. Lukins, "Reliability-based Fatigue Damage Predictions under Random Vibration Environment," Presented at the AIAA/ASME/ASCE/AHS 24th Structures, Structural Dynamics, and Materials Conference in Lake Tahoe, Nevada, May 2-4, 1983. Y. S. Shin and R. W. Lukins, "Probability-based High-cycle Fatigue Life Predictions," Presented at the ASME 4th National Congress on Pressure Vessel and Piping Conference in Portland, Oregon,June 19-24, 1983.

Thesis Directed: R. W. Lukins, "Probabilistic Fatigue Life Predictions of Structural Components in High-Cycle Fatigue Regimes," Master's Thesis, June 1983.

Title: Development of a Library of Numerical Optimization Programs for Engineering Design

Investigator: Garret N. Vanderplaats, Associate Professor of Mechanical Engineering

Sponsor: NPS Foundation Research Program

Objective: To develop a library of FORTRAN programs for engineering design optimization using state-of-the-art techniques.

Summary: The FORTRAN program was completed and initial testing was done. A preliminary version of the code was delivered to the principal sponsor. Dr. H. Sugimoto was employed for one year as a senior research associate to aid in program development and checkout.

The final version of the program, together with documentation, is expected to be delivered to the NASA sponsor in early 1984, with work in the area of optimum sensitivity continuing for the remainder of FY84.

Publications;

Vanderplaats, G.N., Sugimoto, H., and Sprague, C.M., "ADS-1: A General-Purpose Optimization Program", Proc. 24th AIAA/ASME/ASCE/AHS Structures, Structural Dynamics and Materials Conference, Lake Tahoe, Nevada, May 1983. (Accepted for publication, AIAA Journal).

Vanderplaats, G.N., "A Robust Feasible Direction Algorithm for Design Synthesis", Proc. 24th AIAA/ASME/ASCE/AHS Structures, Structural Dynamics and Materials Conference, Lake Tahoe, Nevada, May 1983. (Accepted for publication, AIAA Journal).

Vanderplaats, G.N., "The ADS General-Purpose Optimization Program", Proc. Symposium on Recent Experiences in Multidisciplinary Analysis and Optimization, NASA Langley Research Center, Hampton, VA, April 24 - 26, 1984.

Vanderplaats, G.N. and Yoshida, N., "Efficient Calculation Optimum Design Sensitivity", Proc. 25th AIAA/ASME/ASCE/AHS Structural Dynamics and Materials Conference, Palm Springs, CA, May 14 - 16, 1984.

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Absolute Electroacoustic Measurement of Temperature Variations in Superfluid ^{4}He	S. L. Garrett	6.1
Microwave Cerenkov Radiation	J. R. Neighbours F. R. Buskirk	6.1

Summary Title	Investigator	Type Funding
ELECTRICAL AND COMPUTER ENGINEERING		
Computer Region Segmentation of Serial Photographs	C. H. Lee	6.1
Perturbative Model Analysis of the Back-Scattering Characteristics of a Missile over Several Frequency Bands	H. M. Lee	6.1
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Determination of the Influence of Processing History on the Carbon Content of the Martensite in a High-Carbon Bearing Steel by X-Ray Diffraction	T. R. McNelley	6.1
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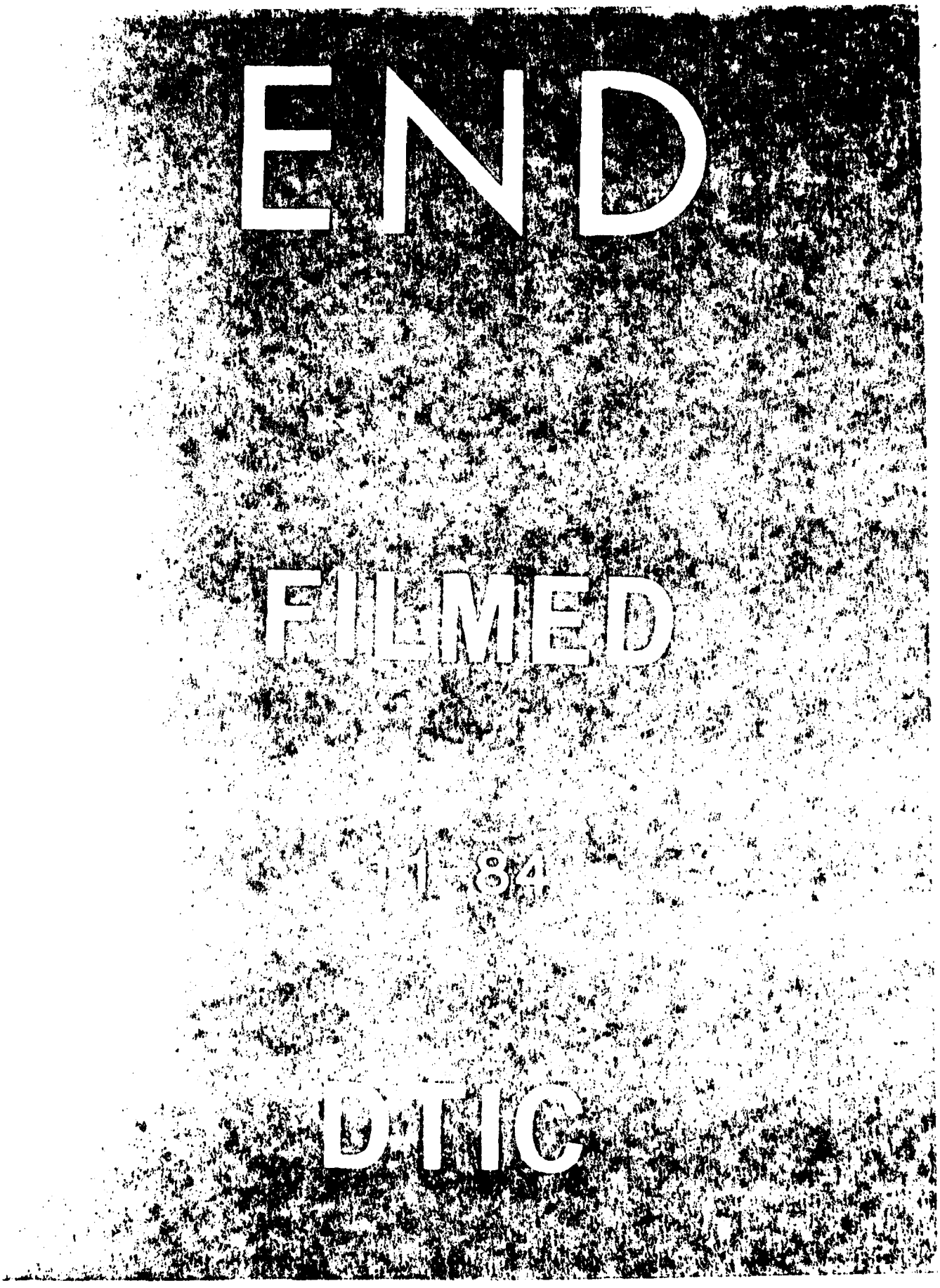
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